REMARKS

Favorable reconsideration in light of the present amendments and following discussion is respectfully requested.

Claims 1-10 are presently pending; Claims 6-10 have been added by the present amendment. No claims have been amended or cancelled herewith. Applicants respectfully submit that no new matter has been added by the present amendment.

Applicants thank the Examiner for the interview granted Applicants' representatives on May 6, 2002. During the interview, the rejection based on Sakurai et al. (U.S. Pat. No. 5,962,877, hereafter Sakurai) in view of Sakurai et al. (JP411284176A, hereafter JP '176) and Okamoto et al. (U.S. Pat. No. 4,903,177, hereafter Okamoto) were discussed. The Applicants' representatives discussed that the teachings of the references do not provide any motivation for the proposed combination, and the Applicants representatives agreed to submit further comments in light of the interview discussion.

In the outstanding Office Action, Claims 1-3 and 5 were rejected under 35 U.S.C. § 103(a) as unpatentable over Sakurai in view of JP '176 and Okamoto; and Claim 4 was rejected under 35 U.S.C. § 103(a) as unpatentable over Sakurai in view of JP '176 and Okamoto as applied to Claims 1-3 and 5, and further in view of Kim et al. (U.S. Pat. No. 6,229,166, hereafter Kim).

Claim 1 recites: "A field-effect semiconductor device having a semiconductor layer of ... a base region ... formed as part of the upper surface of said semiconductor layer, at least one pair of emitter regions ... formed as part of the upper surface of said base region, an insulating layer ... formed to contact said base region ... a gate electrode that is placed on the upper surface of said insulating layer, an interlayer insulating film that is formed to cover said gate electrode, a barrier metal that is formed to continuously contact said interlayer insulating film, base region, and emitter regions, and an emitter electrode that is formed on

the upper surface of said barrier metal layer, characterized in that said barrier metal layer ... comprises a layer containing nitrogen." Through the Applicants' novel configuration, p-base density may be raised to obtain the same threshold voltage by forming a barrier metal layer containing nitrogen. As a result, the pinch resistance of the p-base region immediately beneath the n^+-emitter regions can be lowered, so that an IGBT having a greater amount of breakdown withstanding can be provided.[1]

Sakurai describes an inverter apparatus having an improved switching element. Sakurai focuses on controlling the band-gaps of the semiconductors used to form the semiconductor layers.[2] Sakurai uses the specified band-gaps to control the amount of loss and leak current, because in semiconductors having a narrow band-gap, the loss becomes large at a high temperature state.[4] Sakurai does not disclose or suggest that controlling the band-gap of the semiconductors used to form the semiconductor layers is inadequate in reducing the loss and leak current of the semiconductor device. Sakurai also does not address the problem of increasing the amount of breakdown withstanding. Yet another facet of the invention that Sakurai fails to address is that the emitter is formed of aluminum.

JP '176 describes that its purpose is to provide a semiconductor device in which yield at the wire bonding is improved while maintaining main breakdown strength yield. In so doing, JP '176 seeks to minimize the occurrence of cracking at the wiring bonding. JP '176 does this by providing pure aluminum at an emitter electrode while a barrier layer is provided between the emitter electrode and a MOS gate.

One of several differences between the references to Sakurai and JP'176 is that JP '176 describes an aluminum emitter. JP '176 indicates that the provision of a metal barrier is

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[1]Specification, page 10, lines 12-18.

[2]Sakurai, col. 2, lines 50-55.

[4]Id. at lines 15-20.

useful for an emitter composed of pure aluminum. However, Sakurai fails to disclose or suggest that an emitter is made of aluminum. As the barrier metal layer of JP '176 is specifically noted for its use with pure aluminum in the structure of JP '176, Applicants' respectfully submit that one of ordinary skill in the art would not have been motivated to combine the non-aluminum structure of Sakurai with the barrier metal layer of the differing structure of JP '176. Furthermore, the Office Action fails to point to any teachings within these references in support of the proposed combination. Consequently, Applicants' respectfully submit that the proposed combination is based solely upon improper hindsight, and respectfully request that this ground for rejection be withdrawn.

Okamoto relates to insulating films that have contact holes selectively formed within the films. The film configuration of Okamoto is described to be able to prevent the precipitation of silicon into the contact hole.[5] Okamoto seeks to limit impurity diffusion. However, Okamoto does not disclose or suggest "a barrier metal layer formed to continuously contact said interlayer insulating film, base region, and emitter regions, characterized in that said barrier metal layer that is formed between said emitter electrode and said interlayer insulating film comprises a layer containing nitrogen."

Again, the structure of Okamoto is quite distinct relative to Sakurai and JP '176. Okamoto does not disclose or suggest the use of any type of emitter, regardless of the composition of the emitter. Okamoto instead discloses that the barrier layer and a second metal film are formed adjacent to each other and sintered by heat treatment. In fact, although the second metal layer 6 of Okamoto is described as containing aluminum, Okamoto only describes that boron is prevented from diffusing and silicon is prevented from precipitating.[6] Applicants respectfully submit that Okamoto fails to disclose or suggest a combination with

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[5]Okamoto, Abstract.

[6]Okamoto, col. 3, lines 17-23.

the above-described distinct structures of Sakurai and JP '176. Certainly, the Office Action fails to particularly point to any teachings within the cited references in support of the proposed combination.

Consequently, Applicants respectfully submit that no motivation exists to combine the teachings in Sakurai, JP'176, and Okomoto in the manner suggested in the Office Action. Accordingly, Applicants respectfully submit that this combination is based solely on improper hindsight, and request that this rejection be withdrawn.

In response to the rejection of Claim 4 as unpatentable over Sakurai in view of JP '176 and Okamoto and further in view of Kim. Claim 4 depends from independent Claim 1, and is also allowable.

As noted above, Sakurai, JP '176, and Okamoto, all fail to provide a motivation to combine these references.

Kim discloses a ferroelectric random access memory device and fabrication method therefor. Kim describes providing upper and lower seed layers that are crystallized prior to the ferroelectric layer during a thermal treatment.[7] Kim discloses that an interlayer insulating film is deposited on the entire surface of the substrate in which the transistor is formed.[8]

However, Kim does not disclose or suggest the use of any type of emitter, and certainly fails to disclose that an emitter may be formed of aluminum. Kim further does not disclose or suggest the use of a barrier layer. In light of these deficiencies, Applicants respectfully submit that Kim fails to provide any motivation to modify its teachings in the manner proposed by the outstanding Office Action.

Accordingly, as none of the applied references, either alone or in combination provide a motivation to combine these teachings, it is respectfully submitted that the combination is

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[7]Kim, Abstract.

[8]Id. at col. 4, lines 7-12.

based solely upon hindsight. Applicants therefore respectfully request that this ground for rejection be withdrawn.

New Claims 6-10 are likewise considered to patentably distinguish over the cited references for at least the reasons above noted with respect to Claim 1. Independent Claim 6 further recites that a "semiconductor layer comprises a buffer layer of a first doping concentration and a second layer of a second doping concentration, wherein said first doping concentration is higher than said second doping concentration ...." This feature is believed to be patentably distinguishing over the references of record, and as noted at page 8, lines 5-11, of the specification, this configuration provides "an advantage of comparatively low current resistance in the n^- layer 2." The n^- layer corresponds to the "second layer of a second doping concentration," as recited in Claim 6. Support for new Claims 6-10 may be found, for example, in Figure 1.

Consequently, in view of the foregoing discussion, Applicants respectfully submit that the pending application is in condition for immediate allowance. An early and favorable action is therefore respectfully requested.

Respectfully submitted,

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IN THE CLAIMS

Claims 6-10 (New).